

WHAT IS CLAIMED IS:

1. An ultrasonic transducer driver comprising:  
a giant magnetostrictive element,  
5 a fastener for holding the giant magnetostrictive  
element under mechanical pressure,  
a first field generator for providing a magnetic bias  
field,  
a second field generator for providing a magnetic  
10 drive field, and  
a magnetic circuit for channelling the magnetic  
fields in the magnetostrictive element.
2. The driver of claim 1 wherein the giant  
15 magnetostrictive element is a rare-earth-alloy-based  
material.
3. The driver of claim 1 wherein the giant  
magnetostrictive element is Terfenol-D and its composites.
- 20 4. The driver of claim 1 wherein the giant  
magnetostrictive element is cylindrical with a central  
hole.

5. The driver of claim 1 wherein the giant magnetostrictive element is a composite comprising two or more rare-earth-based alloy parts separated from one another by a layer of passive polymeric material.

5

6. The driver of claim 1 wherein the fastener is a threaded shaft and a nut made of nonmagnetic metallic material.

10 7. The driver of claim 1 wherein the first field generator is a permanent magnet.

8. The driver of claim 1 wherein the second field generator is an electric coil.

15

9. The driver of claim 1 wherein the magnetic circuit is a magnetic enclosing circuit having a pair of magnetic return-path rings and a magnetic return-path cylinder made of high-permeability, high-resistivity and high-saturation  
20 material.

10. An ultrasonic transducer for a bonding apparatus, the transducer comprising:

a horn having a bonding tool at a smaller end and a  
25 mounting collar at an opposite end, and

a driver coupled to the horn, the driver comprising a giant magnetostrictive element, a fastener for holding the giant magnetostrictive element under mechanical pressure, a first field generator for providing a magnetic bias  
5 field, a second field generator for providing a magnetic drive field, and a magnetic circuit for channelling the magnetic fields in the magnetostrictive element.

11. The driver of claim 10 wherein the giant  
10 magnetostrictive element is a rare-earth-alloy-based material.

12. The driver of claim 10 wherein the giant  
magnetostrictive element is Terfenol-D and its composites.  
15

13. The driver of claim 10 wherein the giant  
magnetostrictive element is cylindrical with a central  
hole.

20 14. The driver of claim 10 wherein the giant  
magnetostrictive element is a composite comprising two or  
more rare-earth-based alloy parts separated from one  
another by a layer of passive polymeric material.

15. The driver of claim 10 wherein the fastener is a threaded shaft and a nut made of nonmagnetic metallic material.

5 16. The driver of claim 10 wherein the first field generator is a permanent magnet.

17. The driver of claim 10 wherein the second field generator is an electric coil.

10

18. The driver of claim 10 wherein the magnetic circuit is a magnetic enclosing circuit having a pair of magnetic return-path rings and a magnetic return-path cylinder made of high-permeability, high-resistivity and high-saturation  
15 material.